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## **Hydraulic Unit for Slip-controlled Brake Systems**

### **Technical Field**

**[0001]** The present invention relates to a hydraulic unit, in particular for slip-controlled brake systems.

### **Background of The Invention**

**[0002]** EP 0 787 084 B1 discloses a hydraulic unit of the indicated type which includes a ventilation system with one single ventilation point to the atmosphere aligned coaxially to the motor accommodating bore for the purpose of central ventilation of the accommodating bores. To this end, the motor accommodating bore is configured as a through-bore in the accommodating member. The rear portion of the accumulator accommodating bore is ventilated by way of a complex channel system, comprised of a transverse channel and ventilation slots provided between the motor flange and the accommodating member and between the motor mounting support and the accommodating member.

**[0003]** As an alternative to this presented ventilation concept, another embodiment of EP 0 787 084 B1 discloses connecting the rear chamber of the accumulator accommodating bore directly to the hollow space in the hood which is in fluid-tight abutment on the first housing surface of the accommodating member. Pressure compensation takes place by way of a ventilation point disposed in the hood. Leakage fluid of the pump is not hindered to propagate through the motor accommodating bore into the hood. Said hood accommodates electric and electronic components being disadvantageously exposed to moistening by fluid.

**[0004]** In view of the above, an object of the invention is to improve an immersion-proof hydraulic unit of the indicated type in such a fashion that the ventilation system can be manufactured in a simplified way, with the aim of avoiding the above-mentioned shortcomings.

**Brief Description of The Drawings**

[0005] Figure 1 is a top view of the first housing surface of the hydraulic unit.

[0006] Figure 2 is a side view of the accommodating member at the point of intersection A-A known from Figure 1.

[0007] Figure 3 is another side view of the accommodating member at the point of intersection B-B marked in Figure 1.

[0008] Figure 4 is a cross-section taken through the accommodating member in the area of the pressure-balancing channel in the top view known from Figure 1.

[0009] Figure 5 is an alternative design of a cover for closing two accumulator accommodating bores.

**Detailed Description of The Preferred Embodiments**

[0010] Figure 1 shows a hydraulic unit for slip-controlled brake systems in a top view of a block-shaped accommodating member 3 accommodating inlet and outlet valves in several valve accommodating bores 8 of a first and second valve row X, Y, said valves opening into a first housing surface A1 of the accommodating member 3. Said first housing surface A1 is disposed at right angles between a second and third housing surface A2, A3 which is limited by four lateral surfaces of the accommodating member 3 in total, the edges of which surfaces can be easily seen in Figure 1. Further, sections of a hood 7 that is attached to the first housing surface A1 are sketched in the left-hand area of the accommodating member 3. Hood 7 is conformed to the contour of the accommodating member 3 and covers several inlet and outlet valves inserted into the valve accommodating bores 8. Electric controlling and/or regulating elements are arranged in hood 7 and connected to the inlet and outlet valves and to

an electric motor that is arranged at a housing surface of the accommodating member 3 being positioned diametrically to the first housing surface A1.

[0011] Besides, Figure 1 depicts a cable duct 9 between the two valve rows X, Y and, on top thereof, a pressure compensating channel 1 opening into the first housing surface A1. The vertical sectional planes A-A, B-B extend through the cable duct 9 and the pressure-compensating channel 1, illustrating hereinbelow by way of Figures 2, 3 the course of bores of the ventilation system within the accommodating member 3 that is relevant for the invention.

[0012] Figure 2 discloses the design of the accommodating member 3 along the sectional plane A-A characterized in Figure 1 and extending through the cable duct 9, the pressure compensating channel 1 and through the motor accommodating bore 2 that points transversely to the direction the pump accommodating bore 11 opens into the accommodating member 3.

[0013] The invention arranges that the pressure compensating channel 1, as seen from the second housing surface A2, traverses the motor accommodating bore 2 in the direction of the second housing surface A2 that is positioned diametrically to the third housing surface A3 and bounds the accommodating member 3. The pressure compensating channel 1 is configured as an angular channel and composed of a first and a second blind-end bore pointing to the accommodating member 3 in a particularly simple fashion, to what end the second blind-end bore forming a first and a second pressure compensating channel portion 1a, 1b opens into the second housing surface A2 and extends transversely through the motor accommodating bore 2 up to the ventilation point 6 which is a part of the first blind-end bore. The first blind-end bore opens into the first housing surface A1 and intersects with its end the end of the second blind-end bore to complete the angular channel. The ventilation point 6 includes an element 10 that is permeable to gas, yet impermeable to fluid, and is preferably composed of a semi-permeable membrane.

[0014] It can be taken from Figure 2 that the second pressure compensating channel portion 1b extends between the motor accommodating bore 2 and the ventilation point 6 which opens as a stepped bore into the first housing surface A1 of the accommodating member 3 directly at the end of the second pressure compensating channel portion 1b. The second pressure compensating channel portion 1b traverses the cable duct 9, which is positioned in parallel to the valve accommodating bores 8 and arranged beside the motor accommodating bore 2. Cable duct 9 connects the electric motor inserted into the motor accommodating bore 2 to electric controlling and/or regulating elements arranged beside the first housing surface A1, preferably in hood 7.

[0015] Figure 3 shows a cross-section through the accommodating member 3 starting from the illustration of the sectional plane B-B in Figure 1. Identical with the sectional plane A-A, the sectional plane B-B initially extends along the second pressure compensating channel portion 1b up to the motor accommodating bore 2 and thereafter intersects the cross-sectional area of the accommodating member 3, in which the accumulator accommodating bore 4 is provided. The accumulator accommodating bore 4 houses a spring-loaded piston whose spring is supported on the cover 5 tightly closing the accumulator accommodating bore 4. Chamber 4a connected to the first pressure compensating channel portion 1a is disposed between the piston and the cover 5. Pressure compensation takes place through chamber 4a during the piston movement in the direction of the ventilation point 6, and pump leakage is accepted out of the motor accommodating bore 2 through the first pressure compensating channel portion (1a), to what end the absorptive volume of chamber 4 can be modified in conformity with demand by respectively designing the cover 5. Therefore, the cover 5 has a bowl-shaped design and includes a projecting length Z at the second housing surface A2 in order to increase the volume of leakage absorption.

[0016] Figure 3 further shows the shaft portion of the electric motor necessary for the drive of the pump and substantially receiving the eccentric drive inserted into the motor accommodating bore 2. The eccentric drive actuates the piston pump inserted into the pump accommodating bore 11.

[0017] Instead of the top view of the first housing surface A1 known from Figure 1, Figure 4 shows a top view of a sectional surface which extends in approximation along half the block length of the accommodating member 3 and discloses the two valve rows X, Y with eight valve accommodating bores 8 similar to Figure 1, and the pump accommodating bore 11 arranged exemplarily below the valve rows X, Y. The bore portion of bore 11 forming the pump suction side is respectively connected through a pressure fluid channel conducting the operating fluid to an accumulator accommodating bore 4 which adopts the function of a low pressure accumulator supplying the pressure fluid coming from the outlet valves to the pump. Two parallel arranged accumulator accommodating bores 4 open into the second housing surface A2 at a radial distance from each other. Within this radial distance, the pressure compensating channel 1 extends centrically and thus mirror-symmetrically through the accommodating member 3 from the second housing surface A2 to the ventilation point 6. Both accumulator accommodating bores 4 are closed by one single trough-shaped cover 5.

[0018] The attachment of a one-part cover 5 for the tight closure of both accumulator accommodating bores 4 is equally shown in an enlarged view of Figure 5 on the basis of the illustration according to Figure 4. Said cover 5 is made by non-cutting metal shaping, preferably in deepdrawing, stamping or extruding operations. The pistons inserted into the accumulator accommodating bores 4 are manufactured in the same way. The pressure compensating channel 1 extends up to the cover 5 which, in the present example, has an additional indentation below the one accumulator accommodating bore within its trough contour. Any possible leakage of the pump can initially be admitted in the indentation. At its edge bent at right angles, cover 5 is attached by means of calking of the housing material of the accommodating member 3. Of course, other equivalent attachment provisions by way of operative engagement and molecular bond are also possible.

[0019] Of course the accommodating member 3 also comprises several pressure fluid channels connecting the valve-, pump- and accumulator-accommodating bores and permitting a hydraulic connection between a pressure fluid generator and at least one pressure fluid receiver. However, in order not to become confused, it is omitted to illustrate all pressure fluid channels in which the operating fluid is conveyed.

[0020] Rather, the description concentrates on the essential design innovations for configuring a ventilation system that allows ventilating and venting the pump- and accumulator accommodating bore 11, 4 for pressure compensation to the atmosphere exclusively by way of one single ventilation point 6, to what end the invention focuses on the arrangement and construction of a pressure compensating channel 1, which additionally allows a storage of pump leakage in the area of the accumulator accommodating bore 4.

[0021] Finally, it shall not be left unmentioned that, under the proviso of sufficient space, the pressure compensating channel 1 is manufactured as the only through-bore instead of a blind-end bore so that the through-channel 1 is made in a particularly simple drilling operation in conformity with the demands of automation to extend from the second housing surface A2 to the third housing surface A3, which includes the ventilation point 6 with the fluid-impermeable element 10.

[0022] The invention is advantageous in that, upon request or requirement, one single element 10 can also be arranged in hood 7 so that the ventilation of the accumulator accommodating bores 4 and the pump- and motor accommodating bores 11, 2 is carried out through the ventilation point 6 arranged in the first housing surface A1 in the direction of the large-volume hollow space of the hood 7, which has a connection to the atmosphere through the element 10 especially when the hood 7 is sealed at the accommodating member 3.